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Flavour

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Assimilation of healthy and indulgent impressions from labelling influences fullness but not intake or sensory experience

Peter Hovard* and Martin R. Yeomans

Abstract

Background: Recent evidence suggests that products believed to be healthy may be over-consumed relative to believed indulgent or highly caloric products. The extent to which these effects relate to expectations from labelling, oral experience or assimilation of expectations is unclear. Over two experiments, we tested the hypotheses that healthy and indulgent information could be assimilated by oral experience of beverages and influence sensory evaluation, expected satiety, satiation and subsequent appetite. Additionally, we explored how expectation-experience congruency influenced these factors.

Results: Results supported some assimilation of healthiness and indulgent ratings—study 1 showed that indulgent ratings enhanced by the indulgent label persisted post-tasting, and this resulted in increased fullness ratings. In study 2, congruency of healthy labels and oral experience promoted enhanced healthiness ratings. These healthiness and indulgent beliefs did not influence sensory analysis or intake—these were dictated by the products themselves. Healthy labels, but not experience, were associated with decreased expected satiety.

Conclusions: Overall labels generated expectations, and some assimilation where there were congruencies between expectation and experience, but oral experience tended to override initial expectations to determine ultimate sensory evaluations and intake. Familiarity with the sensory properties of the test beverages may have resulted in the use of prior knowledge, rather than the label information, to guide evaluations and behaviour.

Keywords: Satiation, Labelling, Expected satiety, Sensory properties, Health halos

Background

Amid concerns regarding obesity rates and the related disease risks [1], attention has turned to healthfulness. Consequently, a common marketing strategy is to highlight products' health-relevant properties. However, it is unclear whether consumers benefit from these marketing methods. Cognitive and sensory cues influence various dimensions of eating behaviour from initial food choice decisions [2] to sensory evaluation [3, 4], intake decisions [5, 6] and satiety response [7–12]. Thus, it is plausible that marketing healthiness may influence eating behaviour.

Several studies suggest that products believed to be healthy are over-consumed relative to believed indulgent or highly caloric products despite decreased palatability expectations [10, 13–16]. These findings have been attributed to "halo" effects—positive attitudes towards an aspect of a stimulus resulting in overall positive evaluation or overgeneralizations of positivity to other aspects of that stimulus [17]. In the context of believed-healthy foods, this results in lowered calorie estimations [18]; increased intake norms [13]; attribution of additional, unmentioned, healthy characteristics to products [19]; and holistic judgments of products as healthy or unhealthy [20].

Additionally, expectations can influence eating behaviour and experience. For example, sensory expectations and consequently experience are influenced by available information prior to tasting [4, 21–24]. Consumers also have explicit expectations about foods' satiating potential [25], which can influence portion-size selection [26, 27]. In familiar foods, appetite expectations are generated by learned associations between products and actual satiety

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[28]; however, in novel foods, satiety expectations may be driven by external cues such as physical appearance [29]. It is plausible therefore that labels and health information can influence expected and experienced sensory characteristics and appetite of believed novel products.

However, sensory properties, which may be experienced in conjunction with label information in the “real world”, also provide appetite cues [30, 31]. Expectations are tested against experience and quickly assimilated (ratings move in a direction consistent with the initial expectation) when discrepancies are small or not noticed, whereas if discrepancies are noticed, stimuli are systematically analysed and contrast effects (ratings move in the opposite direction to initial expectations) can occur [4, 32–34]. This implicates a role for the extent of confirmation of pre-taste expectations by oral experience (and cues) provided by foods’ sensory properties in eating experience and behaviour. Existing health information studies [14, 15] did not assess ratings differences between pre- and post-tasting making it difficult to differentiate effects of prior expectations and oral experience on health halo-type effects. It is therefore unclear whether beliefs about products from pre-taste information generate health halos or whether products’ sensory properties override these beliefs in ultimate evaluations and meal decisions.

In the first of two experiments, we tested the hypothesis that health information labelled on a beverage would influence the rated healthiness of the beverage after tasting, decrease its expected satiating power and increase intake. We also predicted that the label would influence ratings of the sensory characteristics. In a second study, we explored how these factors were influenced by the congruence between label information and oral experience. We predicted that congruence in a health-label context would lead to assimilation and thus facilitate the health halo-type factors measured in study 1, relative to incongruently and unlabelled beverages.

Results

Study 1

Outliers classed as two standard deviations above or below the mean intake of the beverage within condition groups were excluded from analyses ($n = 4$). Two participants were excluded due to a computer error. Analyses were performed on 60 participants. Three-Factor Eating Questionnaire (TFEQ) [35] dietary restraint and disinhibition and body mass index (BMI) were non-significant as covariates on all analyses (Fig. 1).

Baseline ratings

At baseline, there were no condition differences in rated hunger, thirst or desire to eat (all $p > .079$). There was an unexpected effect of condition on baseline fullness ($F\ (2,\ 57) = 3.84$, $p = .027$, $\eta_p^2 = .119$), which was higher in the control condition than the indulgent condition ($p = .045$), although the other conditions did not differ significantly (both $p > .072$, Table 1). However, although baseline fullness was subsequently entered as a covariate in analyses, it was not found to co-vary significantly on any analysis.

Healthiness and indulgence ratings

The labels generated appropriate healthiness or indulgent beliefs, but tasting overrode initial impressions, shown by convergence towards the control ratings. However, label effects on indulgent impressions persisted after tasting (Fig. 2a, b). This was supported by significant main effects of condition ($F\ (2,\ 57) = 3.98$, $p = .024$, $\eta_p^2 = .12$) and rating time on healthiness ratings ($F\ (1,\ 57) = 4.98$, $p = .03$, $\eta_p^2 = .08$) and an interaction ($F\ (2,\ 57) = 10.32$, $p < .001$, $\eta_p^2 = .01$). Before tasting, the healthy group rated the beverage as healthier than the indulgent and control groups ($t\ (29.0) = 3.94$, $p = .002$; $t\ (38) = 2.60$, $p = .015$), respectively, and healthiness ratings trended towards being lower in the indulgent than control condition ($t\ (33.46) = 1.87$, $p = .070$). After tasting, there were no differences between conditions (all $p > .05$), suggesting that impressions converged towards the control group following tasting.

There were also significant main effects of condition ($F\ (2,\ 57) = 13.35$, $p < .001$, $\eta_p^2 = .32$) and rating time ($F\ (1,\ 59) = 9.67$, $p = .003$, $\eta_p^2 = .15$) on indulgent ratings and an interaction ($F\ (2,\ 57) = 6.99$, $p = .002$, $\eta_p^2 = .20$). Before tasting, the indulgent group rated the beverage as more indulgent than the healthy and control groups ($t\ (37) = 5.86$, $p < .001$; $t\ (39) = 5.69$, $p < .001$), respectively. The healthy and control groups did not differ ($t\ (37) = 0.36$, $p = .722$). Post-tasting, the indulgent group rated the beverage as more indulgent than

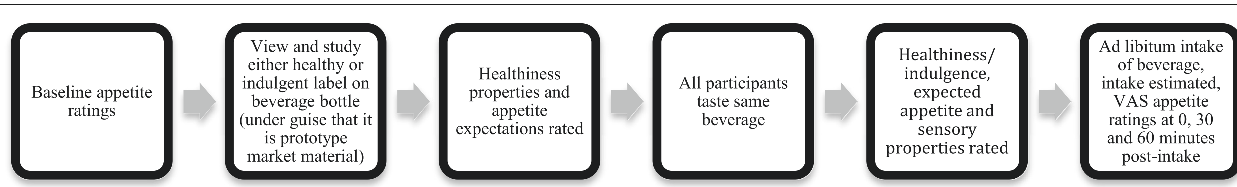

Fig. 1 Brief outline of study 1 design and procedure. A between-subjects one-way design (label condition: healthy, indulgent, no information)

Table 1 Baseline VAS appetite ratings (+/− SEM)

	Hunger	Fullness*	Desire to eat	Thirst
Healthy	41.6 (4.6)	45.2 (4.5)	43.4 (4.6)	56.7 (4.3)
Indulgent	39.7 (5.5)	31.6 (4.1)	47.5 (4.7)	57.8 (3.7)
Control	54.1 (4.4)	30.7 (3.8)	55.7 (3.9)	51.4 (4.8)

* $p = .027$

the healthy group (t (35) = 2.30, $p = .027$) but did not differ from the control (t (39) = 1.20, $p = .238$). The healthy and control groups did not differ significantly (t (38) = 0.94, $p = .351$). These findings suggest some persistence of indulgent label effects to post-tasting.

Expected appetite
There were no significant effects of condition or rating time on appetite expectations (all $p > .05$, Table 2).

Expected and actual pleasantness and sensory ratings
Expected pleasantness was influenced by label condition, but tasting generated convergence with the control (Table 2). There were significant effects of condition (F (2, 57) = 4.03, $p = .022$, $\eta_p^2 = .13$) and rating time (F (1, 57) = 39.61, $p < .001$, $\eta_p^2 = .41$) and a significant interaction (F (2, 57) = 9.04, $p < .001$, $\eta_p^2 = .24$). Before the beverage was tasted, the healthy and indulgent conditions did not differ (t (37) = 0.21, $p = .834$), and both were expected to be more pleasant than the control (t (38) = 3.58, $p = .001$; t (39) = 3.52, $p = .001$), respectively. After tasting, there were no differences between conditions (all $p > .05$). Label condition did not influence the sensory experience associated with the beverage (all $p > .05$, Table 2).

Actual and estimated intake
Unexpectedly, actual intake of the beverage did not differ between label conditions ($p > .05$, Table 3). However, in all conditions, intake was over-estimated. The discrepancy was significantly greater than 0 in the indulgent and control groups (t (20) = 2.53, $p = .020$; t (21) = 2.57, $p = .018$), respectively. However, the healthy group did not differ significantly from 0 (t (20) = 1.42, $p = .170$), and there was no effect of condition on estimated intake ($p > .05$, Table 3).

Appetite ratings
After controlling for intake as a covariate, there were no differences between groups for hunger, thirst or desire to eat ratings either 30 or 60 min following consumption (all $p > .05$, Table 3). After 30 min, there was an effect of condition on fullness (F (2, 59) = 3.69, $p = .031$, $\eta_p^2 = .12$). Participants in the indulgent condition reported greater fullness than the control ($p = .011$), but the other groups did not differ ($p > .05$).

Summary
Study 1 found that label information generated healthiness, indulgent and palatability expectations of a beverage, but tasting largely overrode these expectations. Indulgent ratings persisted following tasting in the indulgent group compared to the healthy group suggesting partial assimilation. Label information did not influence expected appetite, estimated or actual intake or sensory evaluation. However, the indulgent group reported higher fullness ratings after 30 min, perhaps related to assimilation of the label information.

Study 2
One explanation of the effects found in study 1 is that consumers form hypotheses from available information that are tested against oral experience. In this case, experience refuted some of those hypotheses and confirmed others—that the indulgent-labelled beverage was indeed indulgent, which lead to higher fullness. To explore this further, study 2 tested the hypothesis that

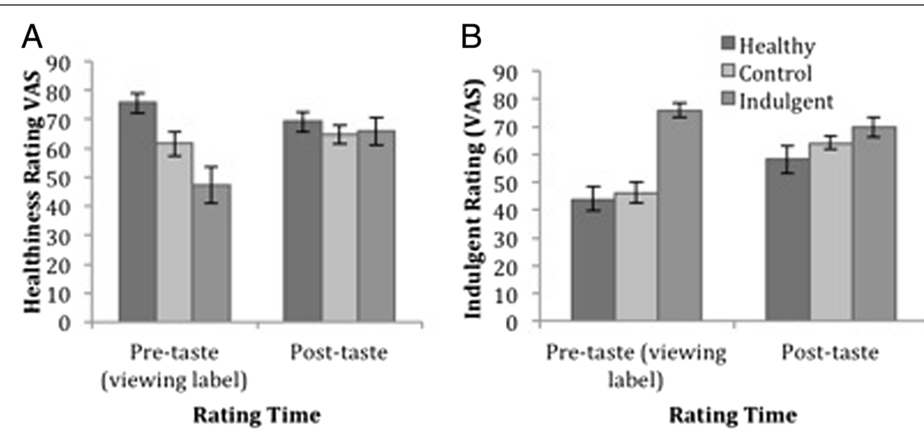

Fig. 2 Ratings of healthiness (**a**) and indulgence (**b**) of a beverage pre- and post-taste in three different healthiness information contexts (+/− 1 SEM)

Table 2 Pre- and post-taste VAS sensory and expected appetite ratings (SEM)

Rating time	Label condition	Pleasant* **	Familiar	Thick	Creamy	Sweet	Expected hungry immediate	Expected hungry later	Expected full immediate	Expected full later
Pre-taste	Healthy	75.4 (3.9)	-				29.8 (4.6)	50.5 (4.3)	70.6 (2.7)	50.7 (4.0)
	Indulgent	54.4 (3.8)					26.8 (3.3)	48.8 (5.1)	67.9 (4.3)	48.6 (5.2)
	No label	73.8 (3.7)					31.9 (3.9)	52.4 (4.2)	67.6 (3.0)	45.5 (4.3)
Post-taste	Healthy	77.7 (4.7)	73.3 (3.3)	62.9 (4.5)	69.5 (3.1)	75.6 (4.0)	34.2 (4.8)	53.4 (4.7)	66.4 (4.8)	50.2 (4.9)
	Indulgent	81.4 (2.8)	77.0 (4.8)	56.1 (4.7)	68.6 (3.7)	78.3 (3.5)	28.4 (4.8)	51.6 (5.4)	65.8 (3.8)	48.7 (5.5)
	No label	82.7 (3.3)	71.1 (4.1)	59.6 (4.7)	65.2 (4.0)	75.0 (2.7)	33.1 (4.6)	50.4 (4.3)	67.4 (4.5)	45.5 (4.8)

*Significant difference between rating times ($p < .001$)
**Significant difference between label groups ($p = .022$)

label-experience congruence would lead to assimilation of initial impressions and incongruence would lead to contrast. Two products, one overtly healthy and the other overtly indulgent, were combined with the labels congruently and incongruently, and the effects on expected and experienced product impressions, appetite and intake were examined (Fig. 3).

Baseline appetite

There were no differences between the beverages or conditions on ratings of baseline hunger, fullness, desire to eat or thirst (all $p > .144$, Table 4).

Manipulation check and label ratings

Manipulation check ratings found the healthy label to be healthier than the indulgent label (t (51) = 14.33, $p < .001$) and the indulgent label more indulgent than the healthy label (t (51) = 9.42, $p < .001$). There were no differences in expectations of product pleasantness (t (51) = 0.61, $p = .546$), but based on the healthy label, the product was expected to be less thick (t (51) = 4.58, $p < .001$), less creamy (t (51) = 11.25, $p < .001$) and less sweet (t (51) = 5.75, $p < .001$) than the product described by the indulgent label. The healthy label was associated with higher expected hunger and lower expected fullness than the indulgent label. This was confirmed by paired-samples t tests for expected immediate and 1-h-later hunger ratings (t (51) = 2.46, $p = .017$; t (51) = 4.42, $p < .001$) and fullness ratings (t (51) = 5.18, $p < .001$; t (51) = 4.34, $p < .001$), respectively (Table 5).

Healthy and indulgent ratings

The beverages differed in healthiness and indulgence, and there were subtle effects of the congruency of the label information (Fig. 4). This was confirmed by a significant effect of beverage (F (1, 75) = 165.31, $p < .001$, $\eta^2_p = .69$), with the healthy beverage rated as healthier than the indulgent ($p < .001$). There was no significant main effect of label (F (2, 75) = 0.17, $p = .844$, $\eta^2_p = .01$), but there was a significant interaction (F (2, 75) = 3.99, $p = .023$, $\eta^2_p = .10$). There was a borderline significant effect of label on the healthy beverage (F (2, 75) = 3.03, $p = .054$), with healthiness rated higher in the congruent than the incongruent condition ($p = .017$) but no other differences between conditions (both $p > .144$). There was no effect of condition for the indulgent beverage (F (2, 75) = 1.10, $p = .34$).

Similarly, there was a significant effect of beverage on indulgent ratings (F (1, 68) = 89.88, $p < .001$, $\eta^2_p = .55$), with the indulgent beverage rated more indulgent than the healthy ($p < .001$). The overall effect of label was not significant (F (1, 68) = 0.17, $p = .68$, $\eta^2_p = .003$), nor was the interaction (F (1, 73) = 0.80, $p = .373$, $\eta^2_p = .01$). There was a significant beverage order effect (F (1, 68) = 7.78, $p = .007$, $\eta^2_p = .10$), which interacted with beverage (F (1, 68) = 4.79, $p = .032$, $\eta^2_p = .07$). With the healthy beverage first, indulgent ratings were higher ($p = .02$), but there was no order effect for the indulgent beverage ($p = .366$).

Sensory characteristics

There were sensory differences between the beverages, with the healthy beverage rated as less familiar (F (1,

Table 3 Intake, estimated intake and the discrepancy between the two (kcal) and VAS appetite ratings 30 and 60 min following intake by label condition

				Rating at 30 min				Rating at 60 min			
	Intake	Estimated	Discrepancy	Hunger	Fullness**	Desire	Thirst	Hunger	Fullness	Desire	Thirst
Healthy	159.00 (29.56)	195.79 (36.79)	36.79 (14.82)	31.1 (4.4)	63.5 (3.5)	31.5 (5.0)	45.6 (5.6)	37.8 (5.4)	54.3 (4.9)	37.8 (5.7)	46.9 (5.3)
Indulgent	169.52 (26.69)	225.56 (31.41)	56.03 (25.37)*	28.8 (5.4)	65.6 (4.9)	32.6 (5.5)	29.4 (5.5)	36.7 (6.2)	57.3 (5.5)	40.1 (6.7)	35.9 (6.2)
Control	183.03 (27.36)	218.42 (25.19)	35.39 (19.49)*	41.5 (5.7)	55.5 (4.7)	42.0 (5.6)	31.9 (5.0)	42.6 (6.4)	52.1 (6.1)	43.9 (6.0)	33.1 (5.5)

*Significantly different from 0 ($p < .020$)
**Significant difference between label conditions ($p = .031$)

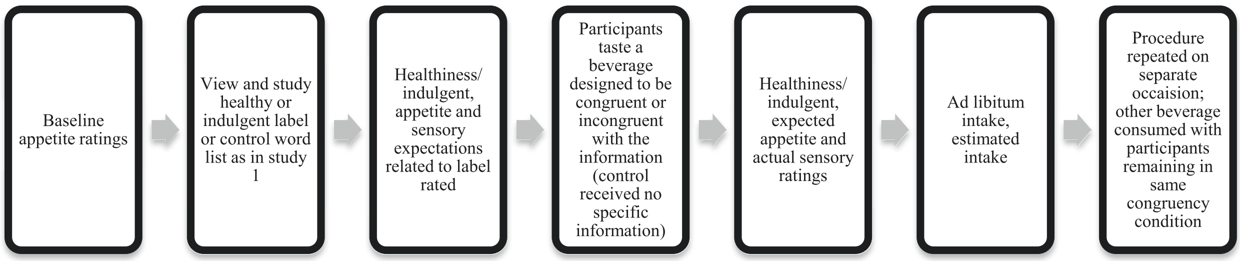

Fig. 3 Brief outline of study 2 design and procedure. A mixed three (information condition: congruent, incongruent or no information; between subjects) by two (beverage: actual healthy or actual indulgent; within subjects) design

75) = 55.05, $p < .001$, $\eta^2_p = .42$), creamy (F (1, 75) = 30.21, $p < .001$, $\eta^2_p = .29$), sweet (F (1, 75) = 14.52, $p < .001$, $\eta^2_p = .16$) and pleasant (F (1, 75) = 46.14, $p < .001$, $\eta^2_p = .38$) but thicker (F (1, 75) = 49.01, $p < .001$, $\eta^2_p = .40$) than the indulgent beverage. There were no significant effects of label (all $p > .200$, Table 5).

Expected appetite

There were no significant effects of beverage (F (1, 75) = 0.06, $p = .815$, $\eta^2_p = .001$; F (1, 75) = 0.42, $p = .518$, $\eta^2_p = .006$) or label condition (F (2, 75) = 0.95, $p = .393$, $\eta^2_p = .03$; F (2, 75) = 0.33, $p = .722$, $\eta^2_p = .01$) on ratings of expected immediate or 1-h-later hunger, respectively. Similarly, there were no significant effects of beverage (F (1, 75) = 1.65, $p = .203$, $\eta^2_p = .02$; F (1, 75) = 0.81, $p = .370$, $\eta^2_p = .01$) or label condition (F (2, 75) = 1.20, $p = .308$, $\eta^2_p = .02$; F (2, 75) = 0.02, $p = .978$, $\eta^2_p = .001$) on ratings of expected immediate or 1-h-later fullness, respectively, (Table 5).

Intake

Intake of the indulgent beverage was higher than that of the healthy beverage (Fig. 5a) (F (1, 75) = 12.84, $p < .001$, $\eta^2_p = .15$), but labelling had no significant effect on intake (F (2, 75) = 0.97, $p = .385$, $\eta^2_p = .03$), and there was no interaction (F (2, 75) = 4.23, $p = .018$, $\eta^2_p = .10$). Healthy beverage intake was underestimated (Fig. 5b), differing from 0 in the congruent (t (25) = 4.55, $p < .001$), incongruent (t (25) = 3.90, $p = .001$) and control groups (t (25) = 3.07, $p = .005$), but not for the indulgent beverage (all $p > .124$). The beverages differed in discrepancy (F (1, 75) = 27.06, $p < .001$, $\eta^2_p = .27$), but not the label groups (F (1, 75) = 0.42, $p = .662$, $\eta^2_p = .01$), and there was no interaction (F (1, 75) = 1.80, $p = .173$, $\eta^2_p = .05$).

Discussion

Over two studies, we tested the hypotheses that healthy labelling of a beverage would increase healthiness impressions, appetite and intake (and vice versa for indulgent-labelled beverages) and influence sensory ratings. Additionally, we hypothesised that label-experience congruency would result in assimilation of healthiness impressions and ultimately enhance health halo effects. We found that whilst the labels themselves were associated with differential healthiness impressions and sensory characteristics, intake and experienced sensory characteristics were unaffected by labelling or the label-experience congruency. We found subtle evidence of assimilation of label information. Study 1 found that indulgent impressions were partially assimilated, which increased short-term fullness, supporting evidence that cognitive cues can influence appetite [8, 10, 36]. Congruency between the healthy label and oral experience in study 2 also led to assimilation. One explanation of assimilation is that minor discrepancies or those that go unnoticed promote rapid evaluation of a stimulus and adoption of consistent elements into the overall evaluation [21, 33, 34]. This is consistent with the present data given that the congruent conditions likely did not generate large discrepancies between expectations and experience. However, despite this

Table 4 Baseline mean (SEM) VAS appetite ratings by label and beverage conditions

Beverage	Label condition	Hunger	Fullness	Desire to eat	Thirst
Healthy	Congruent	52.7 (4.4)	35.2 (4.6)	54.8 (4.3)	57.0 (3.2)
	Incongruent	52.8 (5.2)	34.6 (4.1)	57.1 (5.1)	57.5 (4.0)
	No label	54.6 (4.9)	39.5 (4.8)	58.2 (4.5)	67.8 (2.7)
Indulgent	Congruent	51.4 (5.3)	31.4 (3.7)	50.4 (5.1)	59.2 (4.4)
	Incongruent	54.6 (4.8)	30.0 (5.1)	55.2 (4.8)	63.7 (4.0)
	No label	54.3 (5.0)	34.8 (4.5)	56.2 (5.4)	64.2 (4.5)

Table 5 Mean (SEM) VAS ratings of the labels (part A) and beverages by label condition (part B)

Beverage condition	Label condition	Healthy	Indulgent	Pleasant**	Familiar**	Thick**	Creamy**	Sweet**	Expected hungry immediate	Expected hungry later	Expected full immediate	Expected full later
A)												
Pre-taste label ratings	Healthy	80.9 (2.2)*	45.2 (3.5)*	73.5 (2.5)	-	59.3 (3.1)*	30.5 (3.7)*	61.2 (2.2)*	37.1 (3.2)*	57.5 (2.9)*	53.2 (3.5)*	39.7 (3.5)*
	Indulgent	27.0 (3.2)	84.7 (2.5)	75.6 (3.0)	-	78.6 (2.1)	85.6 (2.4)	78.1 (2.2)	26.8 (2.6)	41.3 (3.1)	74.0 (2.7)	58.3 (3.4)
B)												
Healthy	Congruent	(Fig. 5a)		62.6 (5.6)	59.0 (5.4)	69.4 (3.2)	43.3 (6.5)	71.1 (4.4)	29.6 (3.8)	45.1 (5.0)	70.3 (3.8)	49.9 (4.4)
	Incongruent			63.2 (6.4)	57.0 (6.0)	71.4 (2.9)	41.6 (6.5)	71.4 (4.2)	35.7 (4.4)	55.1 (4.9)	61.5 (3.3)	46.7 (4.6)
	No Label			61.2 (4.3)	52.1 (5.6)	74.1 (2.1)	41.7 (5.3)	62.2 (4.1)	31.2 (4.2)	49.6 (4.0)	71.0 (3.9)	51.9 (3.9)
Indulgent	Congruent	(Fig. 5b)		87.1 (2.5)	86.5 (2.4)	44.0 (4.2)	72.8 (3.8)	75.8 (3.5)	30.9 (4.7)	56.2 (4.7)	73.6 (3.8)	53.2 (5.0)
	Incongruent			86.4 (3.7)	83.0 (3.6)	49.2 (5.3)	66.5 (5.4)	81.4 (2.6)	36.0 (5.5)	51.4 (5.3)	68.5 (4.9)	54.9 (5.3)
	No Label			84.6 (2.8)	80.2 (3.7)	53.4 (5.0)	65.3 (4.2)	78.4 (2.0)	27.4 (4.7)	47.6 (4.5)	70.8 (4.6)	48.8 (5.5)

*Significant difference between label ratings ($p < .017$)
**Significant difference between beverage conditions ($p < .001$)

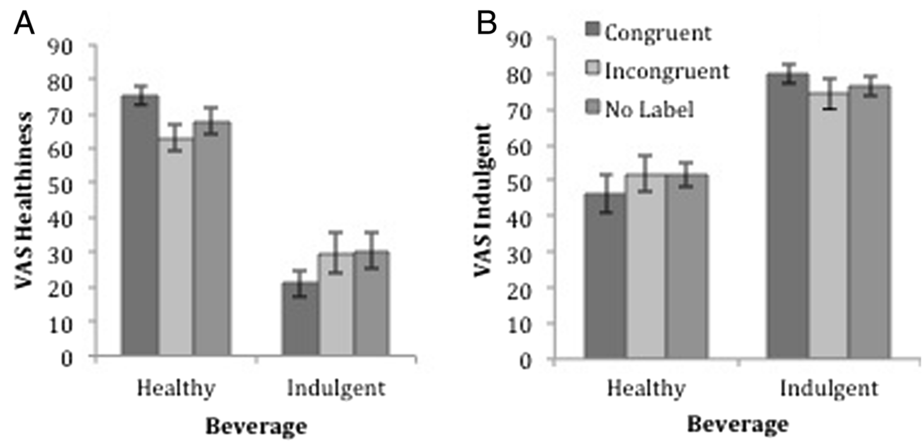

Fig. 4 Healthy (**a**) and indulgent (**b**) ratings of each beverage following congruent, incongruent and no label information (+/− 1 SEM)

assimilation of healthiness ratings, across two studies, we found little evidence of assimilation of pre-taste appetite and sensory expectations associated with the labels.

Incongruence between the label and experience was designed to be extreme in the incongruent conditions; however, there was no evidence of contrast effects—incongruently labelled beverages did not differ from unlabelled beverages in healthiness and indulgent ratings despite initial label rating differences. Some studies have reported contrast effects using food stimuli [4, 34], although contrast effects may be rare [33, 34]. One possibility preventing contrast effects in the present study is that familiarity with the beverages promoted use of schemas rather than expectations to guide evaluations and behaviour. This is consistent with previous studies demonstrating that the influence of expectation congruency depends on prior knowledge—where detailed prior knowledge was available, existing schemas were employed to guide product evaluations and were unaffected by information congruency [37]. Moreover, the labels in the present studies were able to generate pre-taste rating differences in expected satiety and sensory properties but not post-taste differences. Thus, this supports the idea that these initial differences were overridden by tasting, perhaps suggesting that the sensory properties guided evaluations due to prior knowledge of the product types.

The health halo concept predicts that health beliefs lead to lowered calorie estimations and increased intake norms [13, 15, 16, 18]. The two studies here suggest that despite assimilation of healthiness impressions, intake was influenced little. Study 2 suggested that healthy labelling generated lower expected satiety, although neither label congruency nor oral experience differentiated post-taste expected satiety. There is evidence that appetite expectations may be driven by physical characteristics, such as volume, which could have driven ratings overriding the labels' influence [38]. Actual intake was influenced little by label information or congruency, but was greater for the indulgent beverage, despite energy matching. It is likely that this beverage effect was driven by the greater palatability of the indulgent beverage [39]. Additionally, high familiarity of the test products may have again overridden the label influences on intake as consumers were able to employ schema-based intake decisions [37]. Overall, whilst health beliefs were assimilated, intake did not increase.

However, consistent with the health halo idea, intake of the healthy beverage was underestimated. This could be explained as a generalisation of healthy aspects to the whole stimulus [17] such that experiencing it as healthy resulted in the impression that it was lower in energy content. An alternative explanation is that ordinarily, smoothies are relatively less energy dense than presented here (for example, the smoothie used here ordinarily delivers 47 kcal/100 g). Given that there was no effect of label information on intake estimations, it is likely that the estimations were guided by sensory properties and thus previous experience of similar, relatively low-energy, beverages. This suggests that label information was overridden by oral experience, perhaps because of high familiarity, in guiding health halo-type behaviour.

Previous studies paint a mixed picture of the potential of labels to influence eating behaviour. Several studies have demonstrated that label information can alter sensory and hedonic evaluations, satiation and satiety [8, 10, 14, 16, 40]. However, other studies found that labels did not alter the eating experience and that ultimately, foods' actual sensory properties and the post-ingestive experience determined product evaluations and appetite [7, 41]. The present data support some subtle label effects on healthiness impressions and appetite, but even when the label information

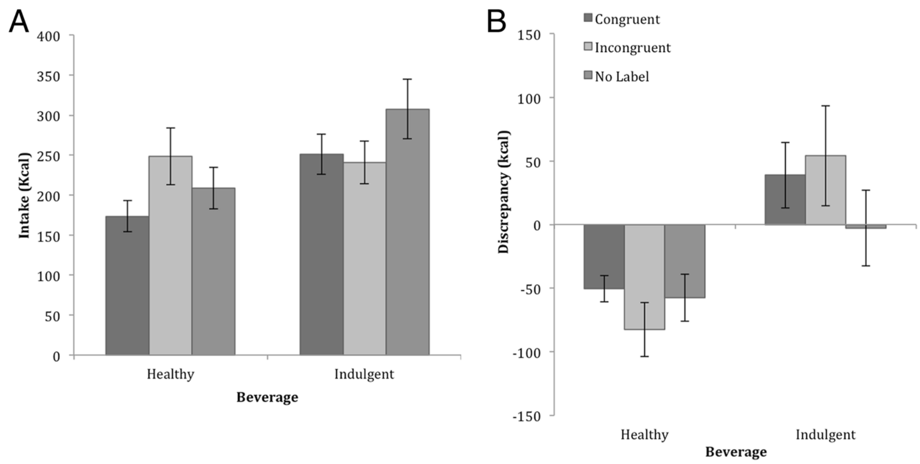

Fig. 5 a Intake (kcal) and **b** discrepancy between actual and estimated intake following congruent, incongruent or no label information (+/− 1 SEM)

generated expectations and was assimilated, the ultimate sensory and hedonic evaluations were unaffected by the health labelling and were determined by actual oral experience. This questions the conditions in which label information can influence eating behaviour. As discussed above, it is possible that familiarity with the oral stimuli may limit the extent to which expectations and labels are recruited in framing evaluations and behaviour. In which case, it may be that familiarity with foods' sensory characteristics promotes use of prior knowledge rather than label influences in determining product evaluations and behaviour.

A limitation of the present study is that whilst we initially separated label believers and non-believers for analysis, we did not measure confidence or strength of the expectations that the labels created per se. It has been argued that assimilation occurs if expectations are strong, promoting rapid accommodation of expectation-experience consistencies [32]. It is possible, but unclear, that in the present study, a lack of confidence in expectations generated by the health information limited the possibility of assimilating appetite or sensory expectations. Indeed, it is possible that the context of consuming the product in a laboratory with experimental labels rather than a genuine consumer product with professional marketing may have influenced the confidence in the authenticity of the labels and product, thus affecting the likelihood of assimilation. A further limitation of the study is that it is unclear whether the assimilated healthy and indulgent beliefs and increased fullness represented a change in experience or merely a rating change. It may be that overall evaluation of the products was framed by initial evaluation rather than a change in actual experience [22].

Given the consistent explanation here that familiarity of the test products could override expectations, future studies could manipulate the familiarity of the test products to assess whether this variable interacts with health impressions to mediate the influence of expectations in intake decisions. It is possible that in less familiar products, external sources of information may be more likely to influence expectations [29] and perhaps experience. Additionally, other sources of information such as visual and olfactory cues may contribute to product expectations and experience [42]. Another potential avenue for future research could be to investigate whether these cues are more likely to guide impressions and behaviour than labels in the same way that oral cues did in the present study. Again, it is possible that the familiarity of these cues may be a factor mediating whether label information is recruited in decision-making. Finally, individual differences in eating behaviour may influence the extent to which external information can modulate appetite experience. Individuals classified as highly restrained may rely more on external cues to assess their appetite experience than those who report low dietary restraint [43]. Therefore, it may be useful for future studies to assess how dietary restraint status mediates the influence of health impressions on appetite, intake and product impressions.

These findings have implications for marketing healthy products, primarily that honest marketing (or that which matches oral experience) is most likely to influence consumers' evaluations of whether a product is healthy. However, in the context of the present findings, these impressions are unlikely to alter the oral or post-ingestive experience of a familiar product. This could imply that health marketing alone may not be responsible for elevated intake of believed-healthy products. It may be difficult to alter the experience of a familiar tasted product through health-relevant marketing.

Conclusions

In summary, the two studies reported here suggest that beliefs about healthiness and indulgence in beverages can be assimilated when oral experience is congruent, that assimilated indulgence may enhance short-term fullness, that healthy labels generate decreased expected satiety and that orally experienced healthy products generate lowered intake estimations. However, despite assimilation of healthiness beliefs and clear pre-tasting rating differences, there was little evidence of label influences on most actual appetite ratings, actual sensory characteristics or intake or post-taste expected satiety. It may be that oral experience of the familiar products dictated these evaluations, rather than labelling or expectations, by recruiting prior knowledge as an evaluation framework.

Methods

Study 1

Design

A mixed three (label: healthy, indulgent or no information; between subjects) by two (rating time: pre and post-tasting; within subjects) design tested the effect of labelling a beverage as healthy, indulgent or providing no explicit information on expected and experienced satiation, satiety expectations and healthiness impressions. Subsequent intake, estimated intake, sensory characteristics and actual appetite were compared between label conditions.

Participants

A power calculation based on data from Provencher and colleagues [14] who reported an effect size of $d = 0.46$ for intake between label conditions suggested a sample size of $n = 63$ with $\alpha = .05$ and power of .9. Females ($n = 66$) were recruited for a study investigating consumer perceptions and memory. Exclusion criteria were as follows: self-reported BMI >30 or <18, smokers of >5 cigarettes per week, pregnant or lactating women, those taking prescription medicine other than the contraceptive pill, diabetes, eating disorders or other gastro-intestinal disorders, allergies or aversions to fruit smoothies, those taking part in ingestive behaviour studies at the University of Sussex or those who had taken part in an earlier pilot study with the test products. Participants were randomly assigned to label conditions.

Materials

Visual analogue scale ratings Participants rated their appetite, expected appetite, the beverage's sensory characteristics and their impressions of the beverage's healthiness using computerised 100-point visual analogue scales (VAS) [44], presented using the Sussex Ingestion Pattern Monitor (SIPM) software [45]. Appetite ratings were presented in the format "How <rating> do you feel?" anchored with "not at all" and "extremely". The ratings were hungry, full, thirsty and desire to eat (presented as "how much of a desire to eat do you feel?"). Expected immediate and 1-h-later appetite ratings (hungry and full) were presented as "How <rating> would you expect to feel immediately/one hour after consuming a bottle the size of the one in front of you?", respectively, anchored as above. The sensory, expected and actual pleasantness and healthiness impressions ratings were presented as "How <rating> is the beverage/would you expect a beverage with this label to be?", respectively, anchored as above. The ratings were pleasant, familiar, creamy, fruity, sweet, thick, healthy and indulgent.

Labels The study needed to use product labels that were believable as either healthy or indulgent products. Initially, 12 potential labels (six healthy, six indulgent) were designed, varying in wording name and layout. In a pilot study, female volunteer participants ($n = 12$) ordered these labels from the healthiest to the most indulgent, and the most often ranked at either extremes were selected for use in the main study (Fig. 6a, b).

Beverages To identify a product that met the study criteria, a pilot was conducted with four commercially available smoothies (all Sainsbury's plc., UK) which were each rated twice, by volunteer female participants ($n = 12$) using VAS for indulgence, healthiness, pleasantness, familiarity, novelty, creaminess and thickness. Of these products, the strawberry and banana

Fig. 6 Selected healthy (**a**) and indulgent (**b**) labels

Table 6 Mean (SEM) ratings of piloted beverage characteristics

	Beverage	Healthy	Indulgent	Pleasant	Familiar	Novel	Creamy	Thick
Taste 1	1	57.5 (8.5)	50.3 (8.2)	74.6 (3.6)	76.9 (4.7)	21.4 (6.5)	41.2 (9.3)	53.0 (8.6)
	2	53.8 (6.3)	51.3 (8.3)	57.1 (8.4)	44.2 (10.7)	54.3 (10.8)	58.4 (9.0)	66.2 (7.6)
	3	44.6 (6.2)	65.4 (5.1)	66.9 (7.7)	61.4 (7.6)	43.5 (8.4)	67.3 (7.8)	70.8 (3.4)
	4	52.3 (7.9)	47.5 (9.2)	67.5 (5.6)	50.6 (9.8)	43.4 (9.4)	56.0 (7.4)	70.5 (5.3)
Taste 2	1	47.3 (8.0)	54.7 (9.1)	74.1 (7.4)	74.8 (4.4)	24.7 (8.1)	41.8 (7.9)	54.3 (7.1)
	2	51.5 (5.9)	54.1 (7.8)	48.8 (8.1)	50.9 (8.5)	43.3 (10.1)	51.1 (11.1)	82.2 (4.4)
	3	41.7 (8.4)	70.9 (8.7)	66.9 (8.8)	59.3 (8.9)	47.9 (8.6)	73.9 (5.4)	69.3 (7.5)
	4	58.6 (7.5)	49.3 (10.1)	71.7 (5.2)	63.9 (8.8)	38.7 (8.2)	61.9 (6.8)	65.9 (6.8)

Beverages: (1) mango passion fruit and goji berry smoothie, (2) strawberry and banana smoothie, (3) pineapple banana and coconut smoothie and (4) orange mango and passion fruit (all Sainsbury's plc., UK)

smoothie was selected as believably healthy or indulgent (ratings did not differ from 50, all $p > .05$, Table 6).

Beverage and label Finally, to ensure that the combination of the selected labels and beverage was rated appropriately in terms of healthiness and indulgence, a third pilot study was conducted. Participants ($n = 12$) were divided randomly into healthy and indulgent label groups to taste the beverage. The healthy group rated the beverage as healthier than the indulgent group (healthy $M = 74.0$, SEM = 11.2, indulgent $M = 51.3$, SEM = 7.0, although not significant, $p > .05$). Unexpectedly, the healthy group ($M = 70.2$, SEM = 7.0) rated the beverage as more indulgent than did the indulgent group ($M = 48.7$, SEM = 4.1, $p = .024$). The original beverage was therefore deemed inappropriate for the study as it was perceived as too indulgent even when labelled as healthy. A secondary test with separate participants ($n = 10$) was conducted using a second drink, the pineapple, banana and coconut smoothie (originally neutral in healthiness and novelty but comparatively indulgent, Table 6). This beverage with the healthy label was rated as healthier ($M = 81.2$, SEM = 3.9) than with the indulgent label ($M = 56.4$, SEM = 12.2) and was rated as more indulgent with the relevant label ($M = 72.8$, SEM = 14.1) than with the healthy label ($M = 62.8$, SEM = 5.3). This beverage was selected as believably healthy or indulgent. The chosen beverage delivered 68 kcal, 0.5 g protein, 12.7 g carbohydrates and 1.6 g fat per 100 g.

Table 7 Mean (SEM) VAS ratings of piloted beverage characteristics

		Healthy	Indulgent	Pleasant	Familiar	Novel
Pilot 1	1	9.5 (3.6)*	88.6 (3.6)*	90.1 (4.0)*	86.7 (4.7)*	10.4 (3.8)*
	2	12.9 (3.8)*	79.7 (4.0)*	72.6 (9.1)*	62.8 (8.5)	47.8 (10.5)
	3	54.0 (7.1)	71.5 (8.4)	81.7 (7.8)*	65.9 (7.6)	29.7 (10.2)
	4	56.2 (9.4)	42.5 (8.2)	71.5 (6.8)*	66.1 (9.4)	28.6 (7.1)*
	5	56.9 (10.4)	36.1 (6.5)	59.4 (10.1)	49.2 (10.8)	46.6 (10.3)
	6	57.5 (9.4)	51.6 (5.0)	70.0 (8.2)*	56.6 (10.4)	46.4 (9.0)
Pilot 2	7	46.9 (8.1)	37.1 (7.1)*	58.4 (5.8)	48.1 (6.2)	61.9 (7.0)
	8	68.6 (4.5)*	55.9 (6.2)	81.8 (2.0)*	54.3 (8.3)	56.1 (7.2)
	9	31.2 (7.0)*	43.4 (9.3)	49.4 (7.2)	56.7 (7.1)	37.2 (9.0)

Beverages: (1) chocolate and vanilla ice cream milkshake, (2) caramel ice cream milkshake, (3) strawberry ice cream milkshake, (4) apple peach and pear juice (Sainsbury's plc., UK), (5) raspberry and pomegranate smoothie (Sainsbury's plc., UK), (6) strawberry and blackberry smoothie (Sainsbury's plc., UK), (7) orange carrot and ginger juice (Sainsbury's plc., UK), (8) innocent apple kiwi and lime smoothie (Coca Cola Co.) and (9) orange and mango juice (Sainsbury's plc., UK)
*$p < .05$

Control materials

A word list of 28 food-unrelated words (Appendix) was presented to the control group to control for the time taken between commencing the study and being presented with the beverage, as well as providing material for the false memory test detailed below.

Procedure

Participants attended the laboratory between 10:30 hours and 13:00 hours having fasted for 2 h prior, aware that the procedure lasted for 90 min and that intake other than the test product was prohibited.

Participants completed baseline VAS appetite ratings before 2 min of studying the assigned label or the control word list. Participants were also provided with an example of the beverage in a 250-ml reference bottle. The label groups were reminded that the information was prototype marketing material for a new product and recall would be tested, and the control group were told that the word list was for a later recall test and that the bottle would be required for answering subsequent questions about beverages.

Participants then completed VAS expected appetite, sensory and healthiness impression ratings (see above). A 20-g sample of the beverage was provided for tasting, and further expected appetite, sensory and healthiness ratings were completed. An 800-g opaque jug of the beverage and a transparent 300-ml glass were then provided, and participants were instructed to serve and consume as much or as little as they would like and were told that more was available on request. VAS appetite ratings were completed and participants estimated their intake (kcal), with reference to information that an equal glass-full amount of orange juice contained 120 kcal.

Participants then waited in the laboratory for 60 min completing VAS appetite ratings at 30-min intervals before a free recall test was administered to uphold the cover story. Finally, participants completed questions assessing whether they believed the label manipulation, height and weight were recorded, and they were fully debriefed.

Ethical approval to run the study was granted by the University of Sussex Life Sciences and Psychology Research Ethics Committee. Informed consent was gained for participation and use of data.

Analysis

Mixed three by two analyses of variance (ANOVAs) were used to contrast the label conditions (between subjects) and pre- and post-taste rating times (within subjects) on impressions of healthiness, expected appetite and expected and actual sensory characteristics. One-way ANOVAs assessed the effect of label condition on intake, estimated intake and the discrepancy between the two. The discrepancy was also compared to 0 (being the perfect estimation). Finally, one-way ANOVAs were conducted on post-intake appetite ratings by label condition, controlling for intake as a covariate. All analyses were conducted on the whole dataset as well as splitting believers and non-believers ($n = 11$). This was found to have no effect, so the results reported contain the entire dataset.

Study 2

Design

A mixed three (congruency condition: congruent, incongruent or no information; between participants) by two (beverage received: healthy or indulgent; within participants) design explored the effect of label congruency on product impressions, expected and experienced appetite, sensory characteristics and intake. As in study 1, labels were presented with a beverage for rating and subsequent tasting and ad libitum intake. Study 2's manipulation differed in that two beverages were consumed, one overtly healthy and one overtly indulgent, on different days, combined with either a congruent, incongruent or no label. Participants were randomly assigned to congruent, incongruent and unlabelled control groups, and beverage order was counterbalanced.

Participants

Females ($n = 75$) adhering to the same criteria as study 1, with the additional requirement that they had not participated in study 1, were recruited.

Materials

VAS ratings Participants completed identical VAS ratings to study 1 measuring appetite, expected appetite and the sensory and healthiness profiles of the beverages. Study 2 also introduced evaluations of sensory characteristics associated with the labels using the same VAS format.

Labels and control word list The study 1 labels were used (Fig. 4) either congruently or incongruently with the beverages, and the study 1 word list was used for a control group.

Test products A pilot taste test was conducted using six equicaloric beverages: three milkshakes and three smoothie beverages (Table 7). Participants tasted 30-g samples and completed VAS sensory ratings (Table 7). Chocolate and caramel milkshakes were significantly lower and higher than 50 on VAS healthiness and indulgence, respectively. The chocolate milkshake was significantly higher than 50 in familiarity which was considered an advantage for testing expectations against experience. The milkshake was 37.5 g chocolate and vanilla ice cream (Sainsbury's plc.) and 62.5 g semi-skimmed milk (Sainsbury's plc.) per 100 g and delivered 100.4 kcal, 13.5 g carbohydrates, 3.6 g fat and 3.5 g protein per 100 g. None of the beverages were deemed appropriate as overtly healthy, so further three beverages were tested on new participants ($n = 9$, Table 7). The apple, kiwi and lime smoothie was significantly healthier than 50 and was selected as the typical healthy beverage. The beverage contained 84.5 g innocent apple, kiwi and lime Smoothie (Coca Cola Co.) and 15.5 g maltodextrin (Cargill, UK) per 100 g energy-matched to the milkshake and delivered 100.3 kcal, 23.6 g carbohydrates, 0.1 g fat and 0.3 g protein per 100 g.

Procedure

The procedure was identical to study 1 except that the reference bottle was empty. This was because some participants received an incongruent label-beverage combination and the sight of the actual beverage may have generated expectations that challenged the label manipulation.

Ethical approval to run the study was granted by the University of Sussex Life Sciences and Psychology Research Ethics Committee. Informed consent was gained for participation and use of data.

Data analysis

Three by two ANOVAs compared the effects of label congruency (between participants) and actual beverage (within subjects) on expected appetite, intake, estimated intake and sensory and healthiness impressions. Pre-taste VAS ratings of appetite expectations, healthiness, indulgence and sensory characteristics were analysed as manipulation checks. In study 1, the beverage was in view and thus, expectations could be rated. However, here, the label was not linked to the product at the point of rating and ratings were considered for the labels rather than expectations of the beverage. For these ratings, those who saw the healthy label (congruent healthy and incongruent indulgent) and the indulgent label (congruent indulgent and incongruent healthy) were grouped, respectively. Analyses initially included beverage order, BMI and dietary restraint and disinhibition but were removed as non-significant covariates, except where stated. Analyses were run separately with reported believers and non-believers as in study 1, but there were no differences so analyses reported here contain the entire dataset.

Appendix

Control word list

Boot, Brace, Brown, Bulb, Currency, Invoice, Parallelogram, Raven, Russia, Triangle, Afterthought, Bus, Cougar, Ethiopia, Gondola, Hardcover, Michelle, Priest, Save, Butane, Colt, Cylinder, Fang, Font, Organisation, Spring, Step-mother, Unit

Abbreviations

ANOVA: Analysis of variance; BMI: Body mass index; SIPM: Sussex Ingestion Pattern Monitor; TFEQ: Three-Factor Eating Questionnaire; VAS: Visual analogue scale.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

PH and MRY designed the study. Materials were generated and data was collected by PH and analysed by PH and MRY. The manuscript was drafted by PH and critically revised by MRY. Both authors contributed to and approved the final manuscript. MRY supervises PH's Ph.D. project.

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